Science Planning and Production Scenario

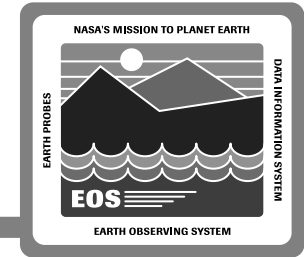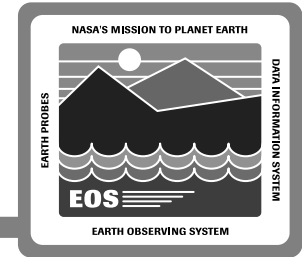## Jolyon Martin

27 September 1995

# Scenario Characterization

- **End-to-End Presentation and Ops Concept**
    - **Integrated View of System Components**
    - **Demonstration of Proposed Design**
   - **Illustration of Operations Control**

End-to-End Scenario

0. **Load Resource Descriptions**
1. **Capture PGE Profile**
2. **Set Up Subscriptions**
3. **Describe Production Goals Through Production Requests**
4. **Resource Planning to define non-production events**
5. **Candidate Plan Generation**
    - **Planning Algorithm**
6. **Activate Production Schedule**
    - **Feedback from Processing**
7. **Coordinate Production from Data Arrival**
8. **PGE Execution**

0. Load Resource Descriptions
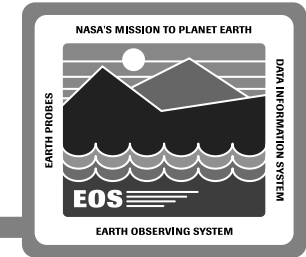
- **MSS Resource Configuration Information used to Initialize PDPS Database for Planning Workbench**
- **Resources Defined for whole DAAC**
  - **Strings**
  - **Computers**
  - **Disks**
  - **Networks**
  - **Services**
- **Planning Workbench Builds Resources Model from Defined Resources**
- **Allocation Scheme Depends on Resource Type**
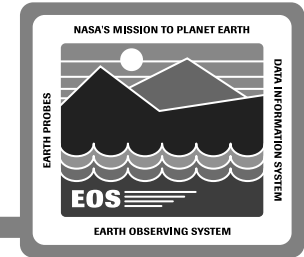
1. Capture PGE Profiles

Occurs in AITTL (PGE Profile Editor)

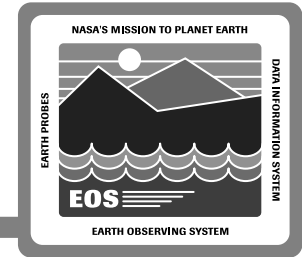**PGE Profile describes the data needed by the Planning Subsystem**

- **PGE Info**
- **Input Data Types - and "requirement"**
- **Output Data Types - and "yield"**
- **Resource Requirements**
- **Performance Statistics**
- **User Parameters**

Planning

- **Provides APIs to AITTL for DB storage of Profile**
- **Supports TRMM Activation Rules at Release A**
- **Uses Modeling data from AHWGP**
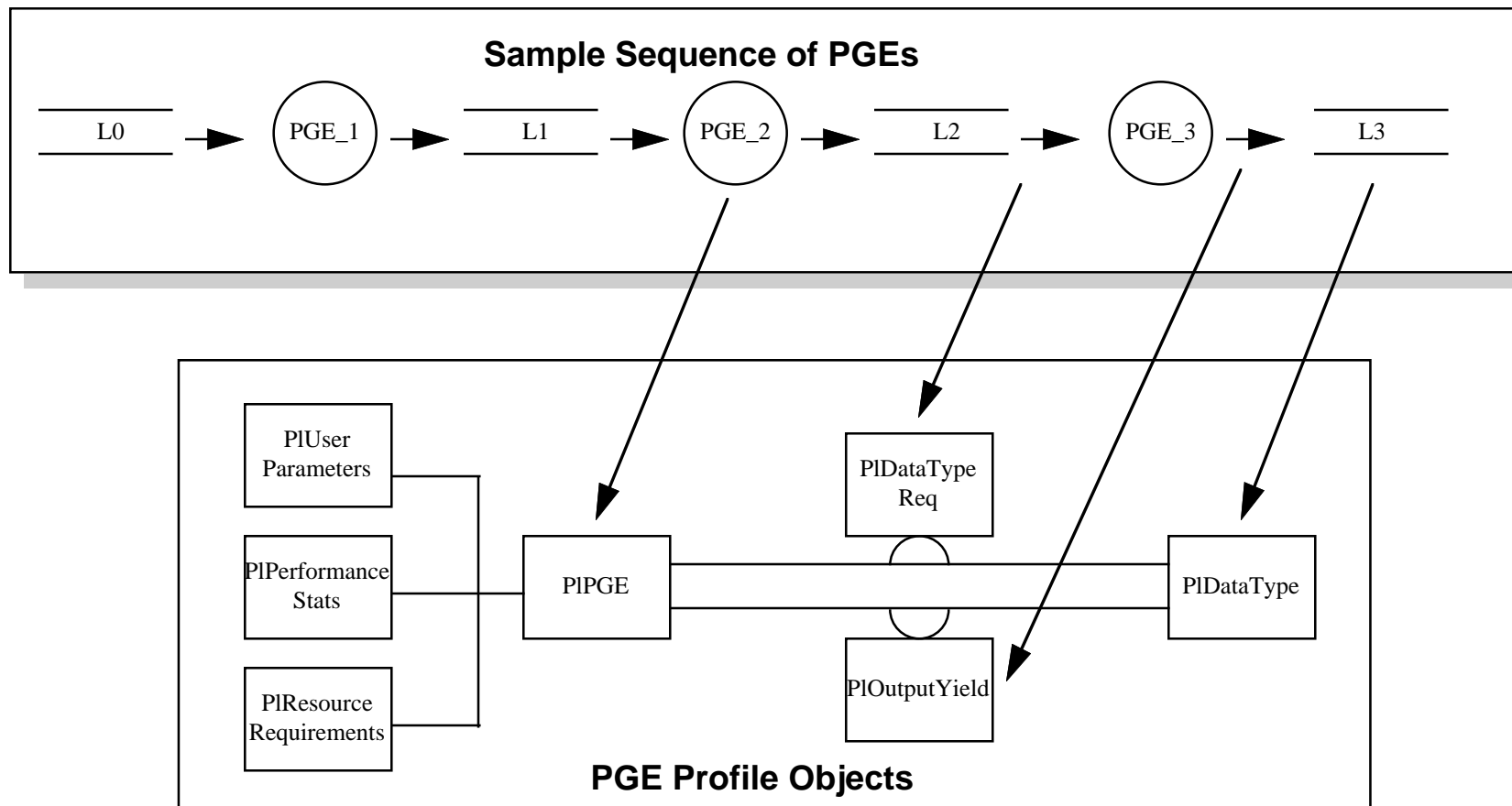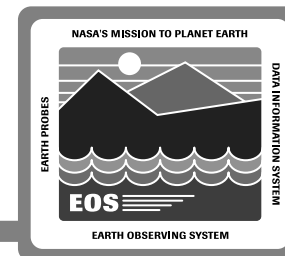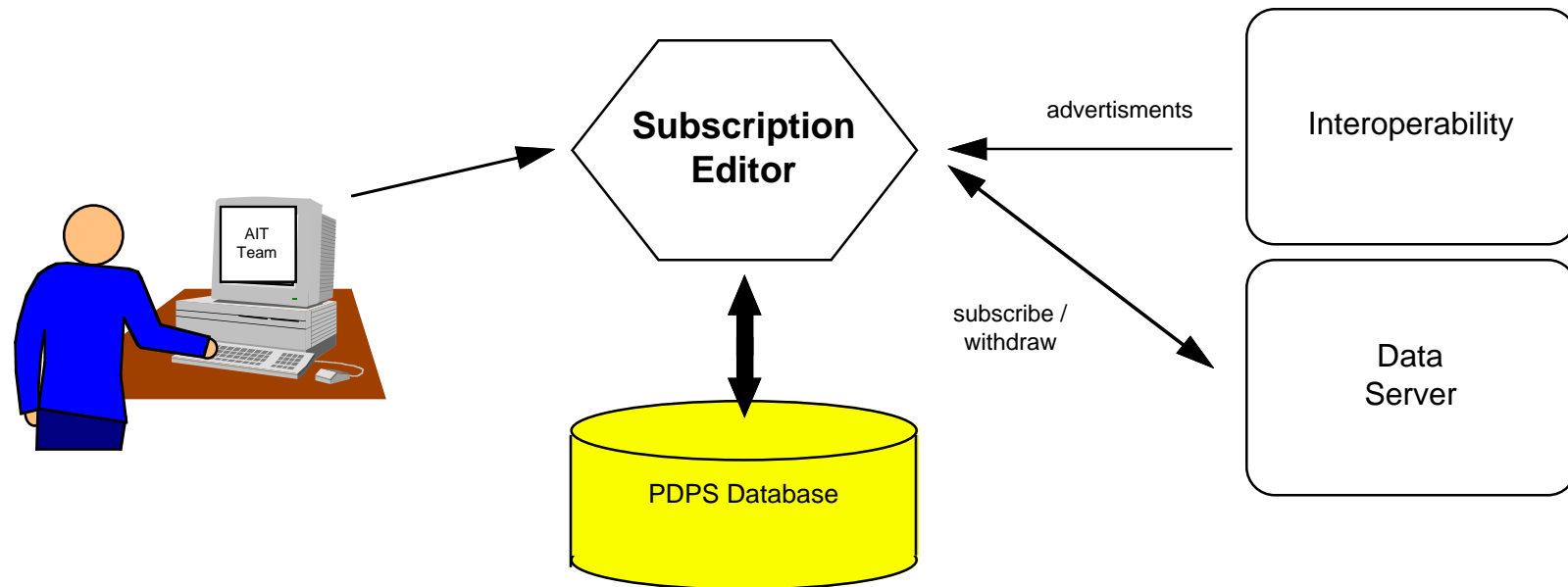
PGE Profile Objects
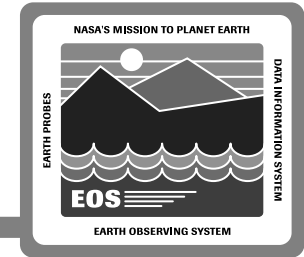
PGE Profile Objects Capture . . .

- **PGE Information**

- **PGE Dependencies - Inputs & Outputs**

- **Information about Inputs & Outputs**

PGE Profile Objects

Sample Sequence of PGEs

L0 → (PGE_1) → L1 → (PGE_2) → L2 → (PGE_3) → L3

PGE Profile Objects

- PlUser Parameters
- PlPerformance Stats
- PlResource Requirements
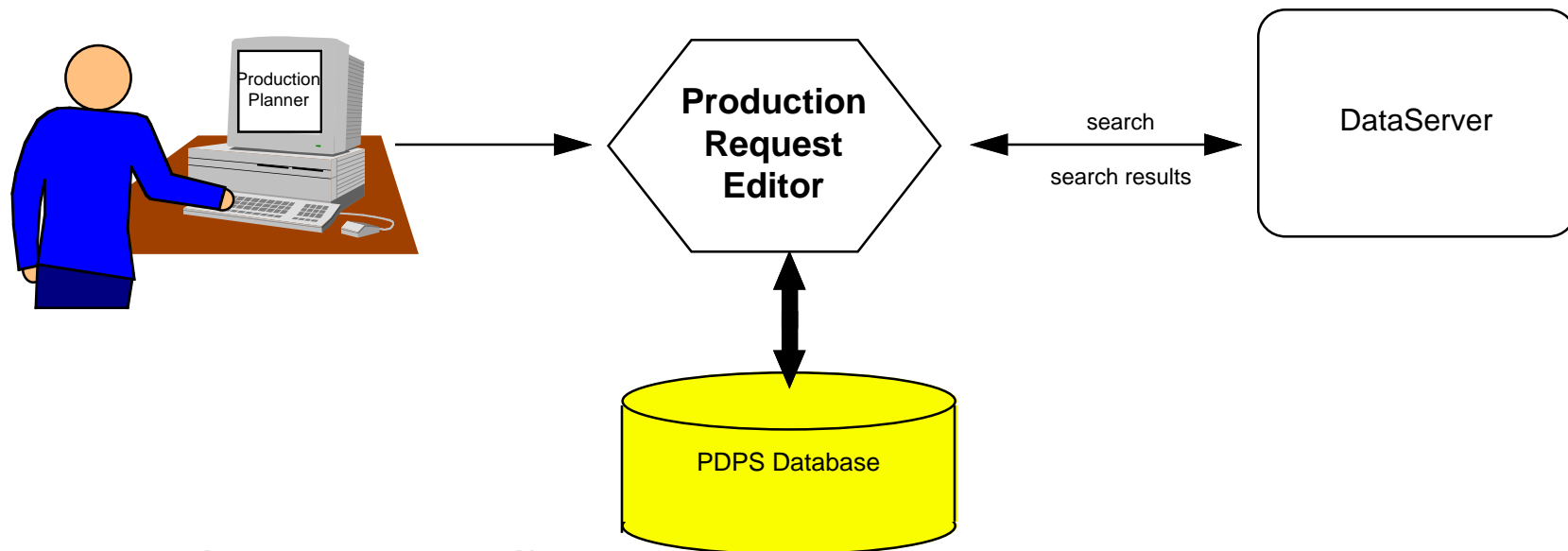
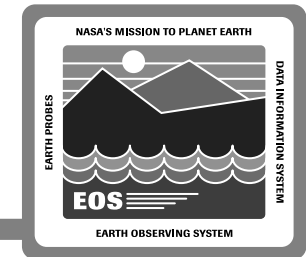PlPGE

PlDataType Req

PlDataType

PlOutputYield

2. Set Up Subscriptions

- **Subscriptions support the Data Driven aspects of ECS production**
- **Planning Subscription Editor Application is mainly re-use of Advertising / Data Server services**
- **Update to Data Type information part of PGE Profile**

3. Entry of Production Requests

- **Production Requests specify**
    - **routine production of data over extended periods**
    - **or activation of PGE over extended periods**
- **Production Request "exploded" into many Data Processing Requests**
- **Translation of "template type" profile information to "specific instance" DPR information**
- **Grouping of multiple requests in later release**
- **Editor provides capabilities to Review / Modify Data Processing Requests**

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Exploding Production Requests

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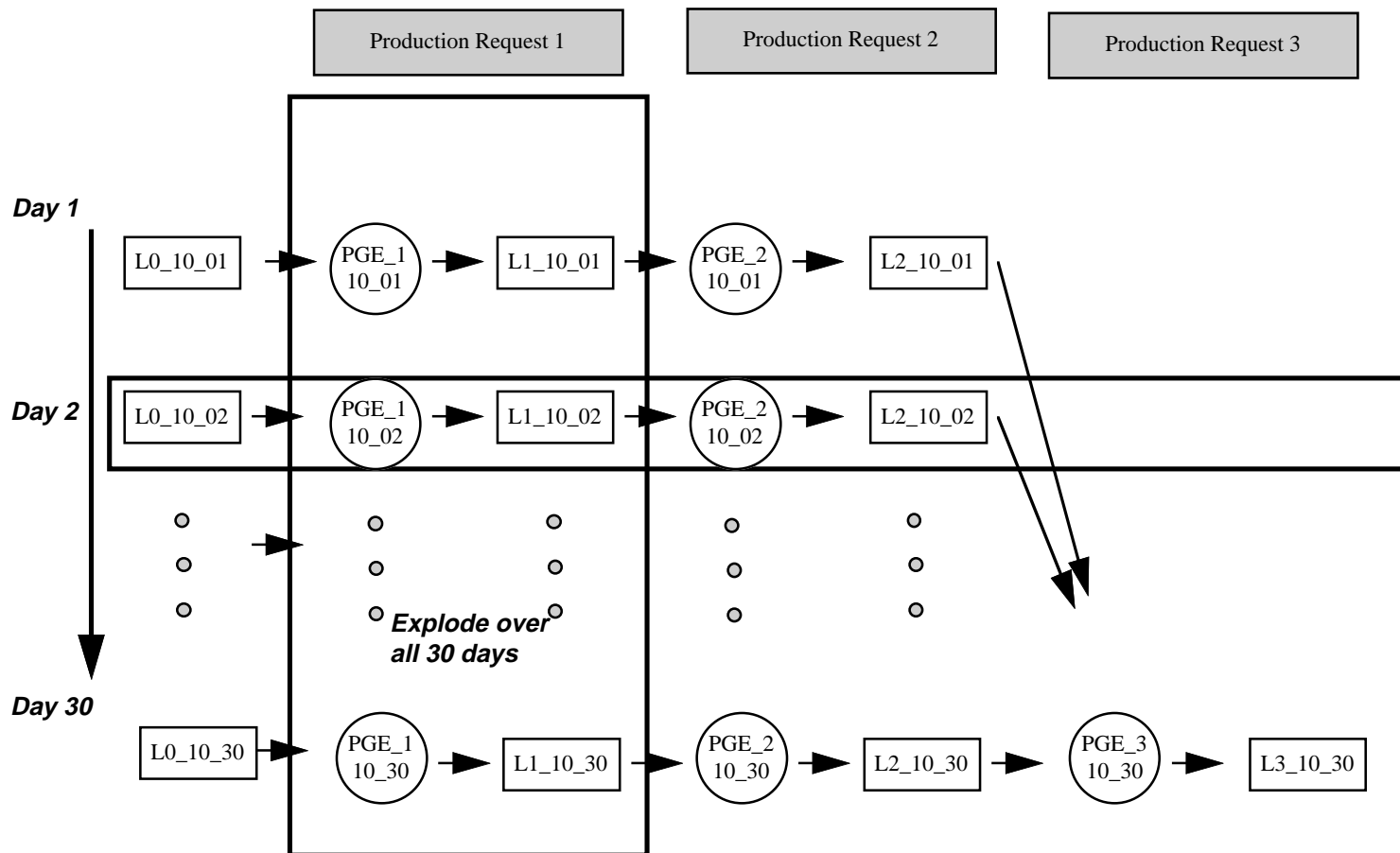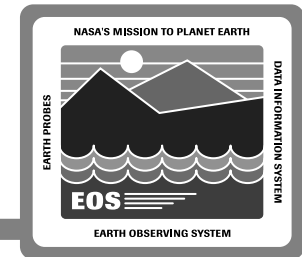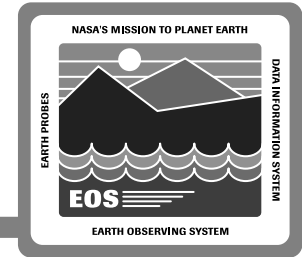
DPR Objects

DPR Objects

- **Capture Information about Individual Processing Requests**

- **Identify Specific Granules Being Produced**

- **Mirror the PGE Profile Objects**

DPR Objects

Data Processing Requests

L0_10_30 → PGE_1 10_30 → L1_10_30 → PGE_2 10_30 → L2_10_30 → PGE_3 10_30 → L3_10_30

DPR Objects

PlDPR — PlDataGranule

PlDataType Req

PlPGE — PlDataType — DsQuery / PlDataSource

PlOutputYield

PlProduction Request — PlDataType Catalogue
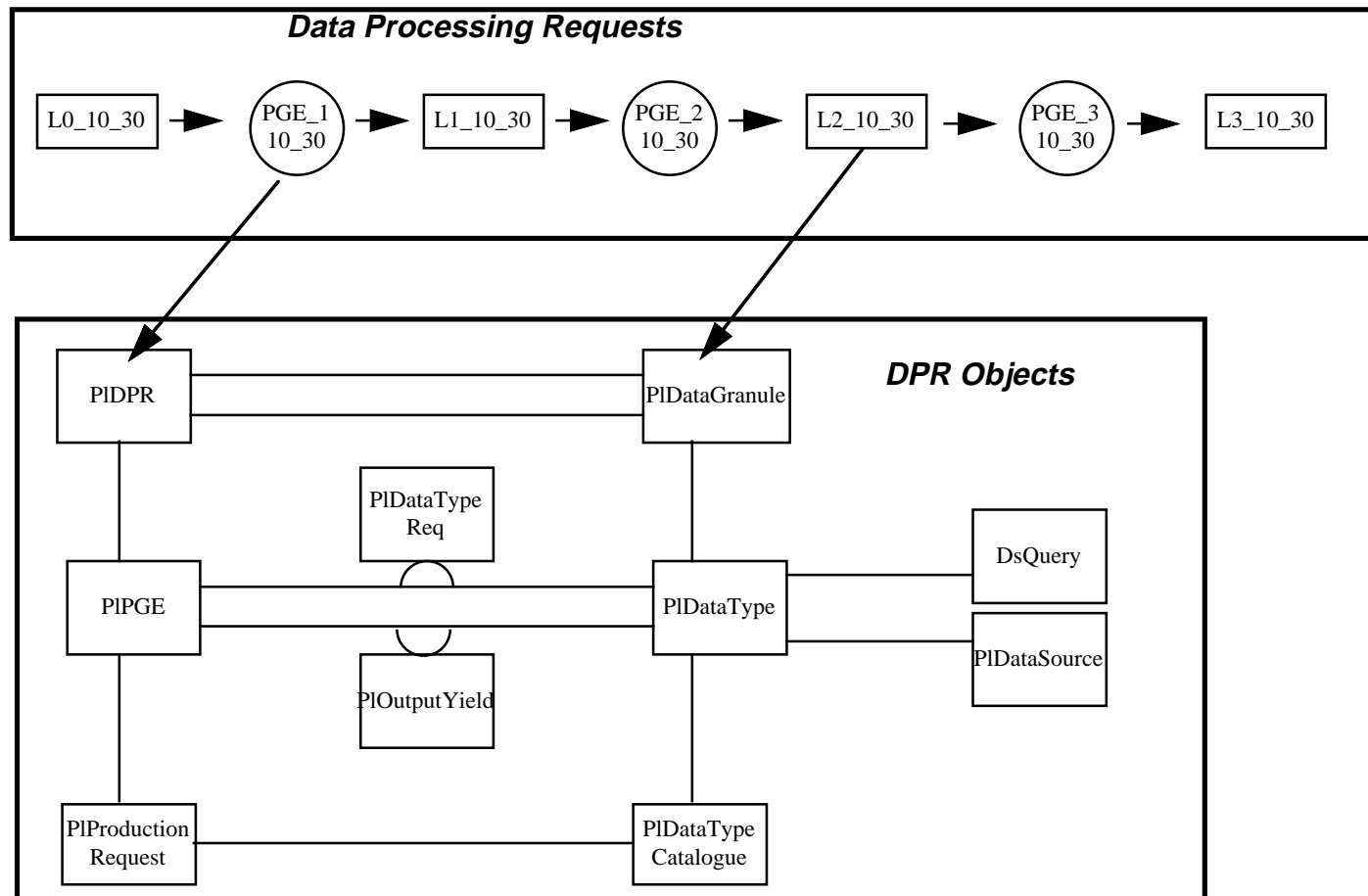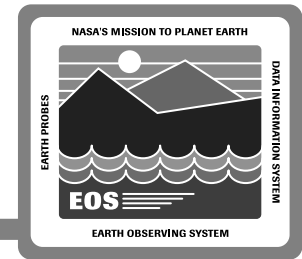
4. Ground Event Resource Reservation
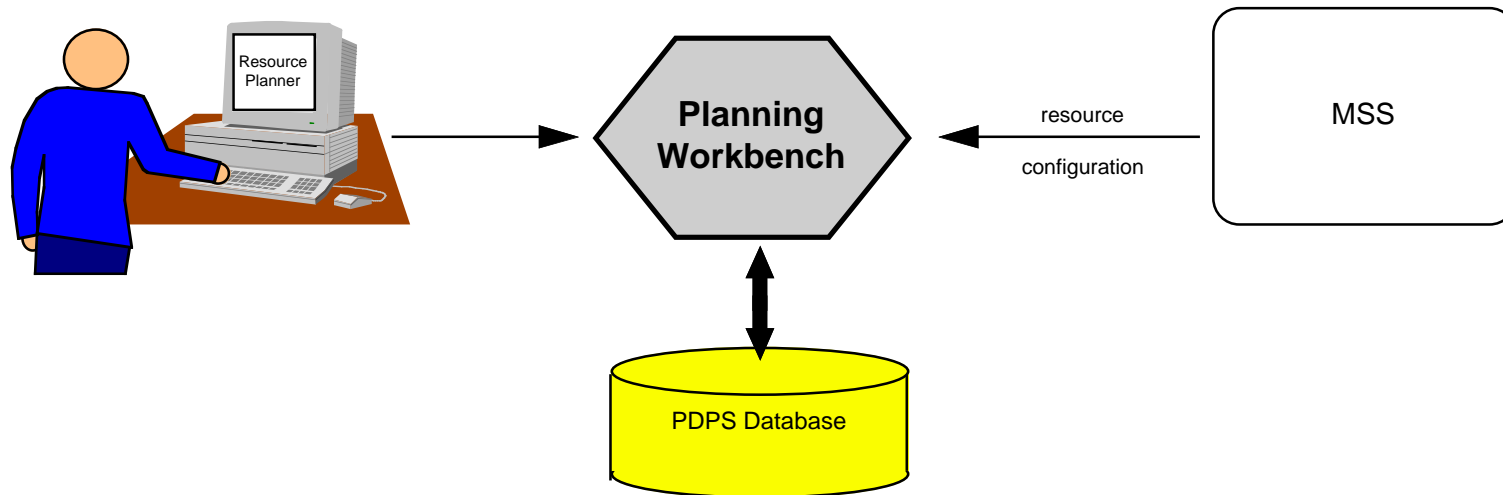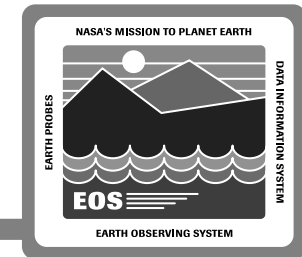
Resource Planner enters predictable ground events against ECS resources

Ground Events specify

- **Event Type / Name**
- **Resource Requirements**
- **Planning Window**
- **Duration**

Ground Event Resource Timeline

CPU1	
DISK1	
CPU2	SSI&T
DISK2	SSI&T
CERES_DSERV	MAINT
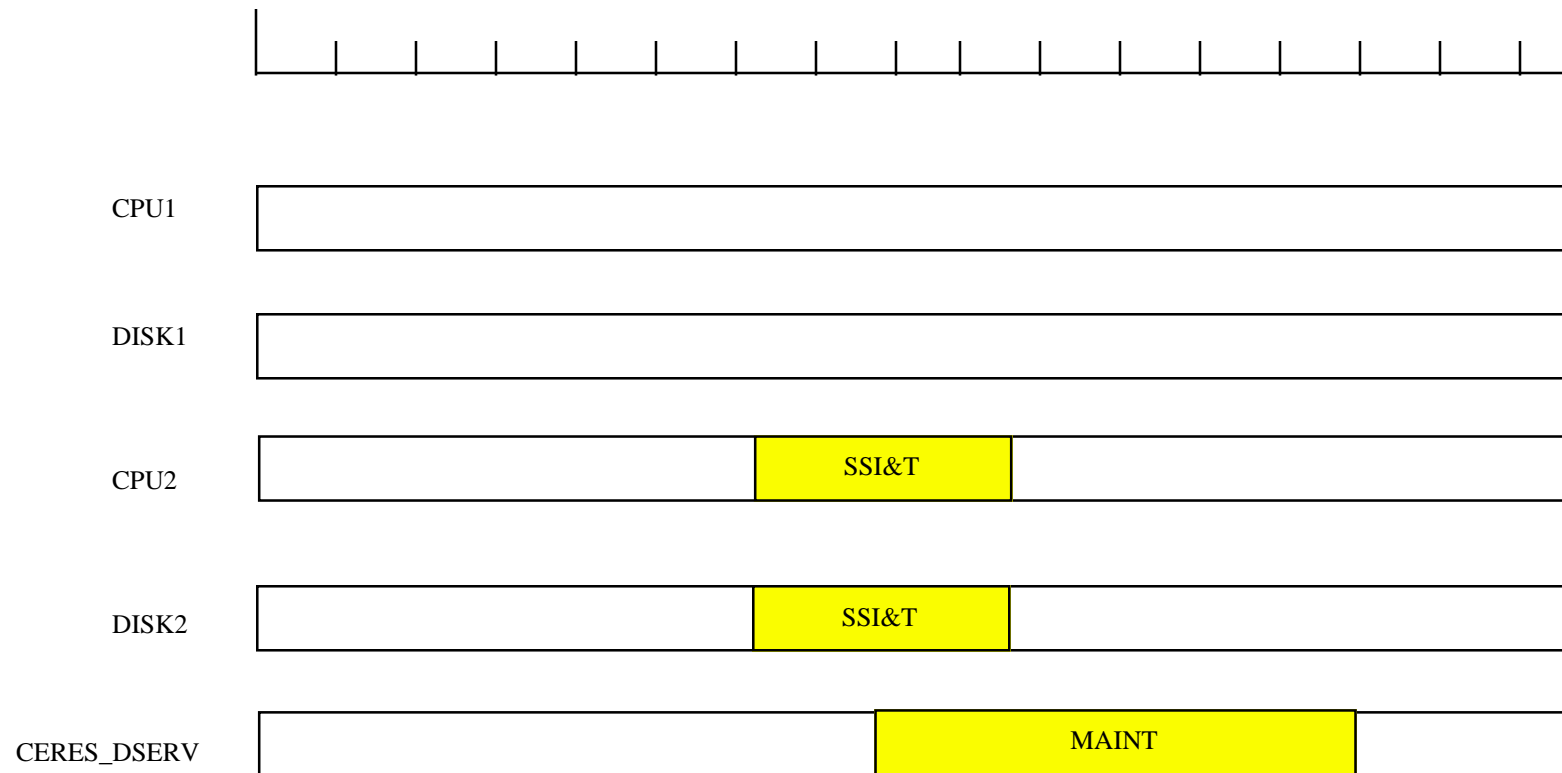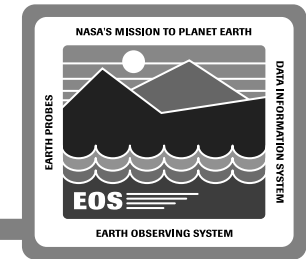
5. Generating Candidate Plans
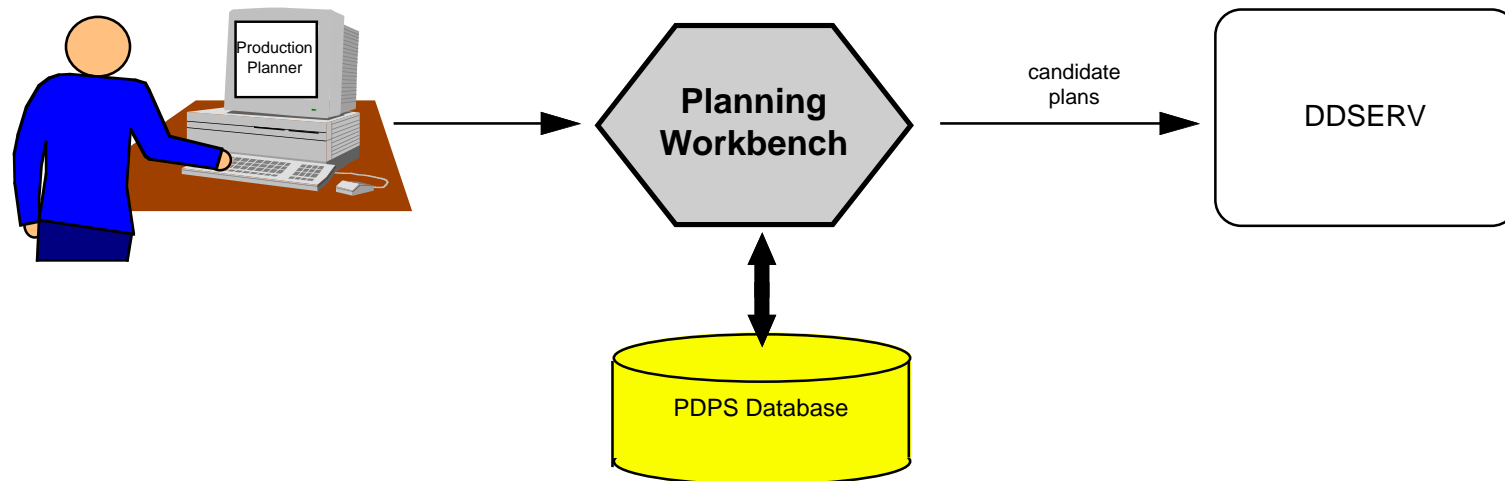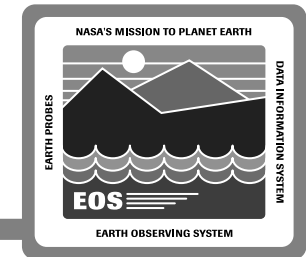
"What If / Candidate Planning" - based on priorities, preferences

- **Predicts execution times for data processing requests and ground events**

GUI & Report Statistics summarize plans for OPS

Plans are available for external view via document data server

Select Production Requests

not-planned   planned

PR_4 CERES 4 OCT

PR_1 CERES 0 OCT
PR_2 CERES 1 OCT
PR_3 CERES 2 OCT
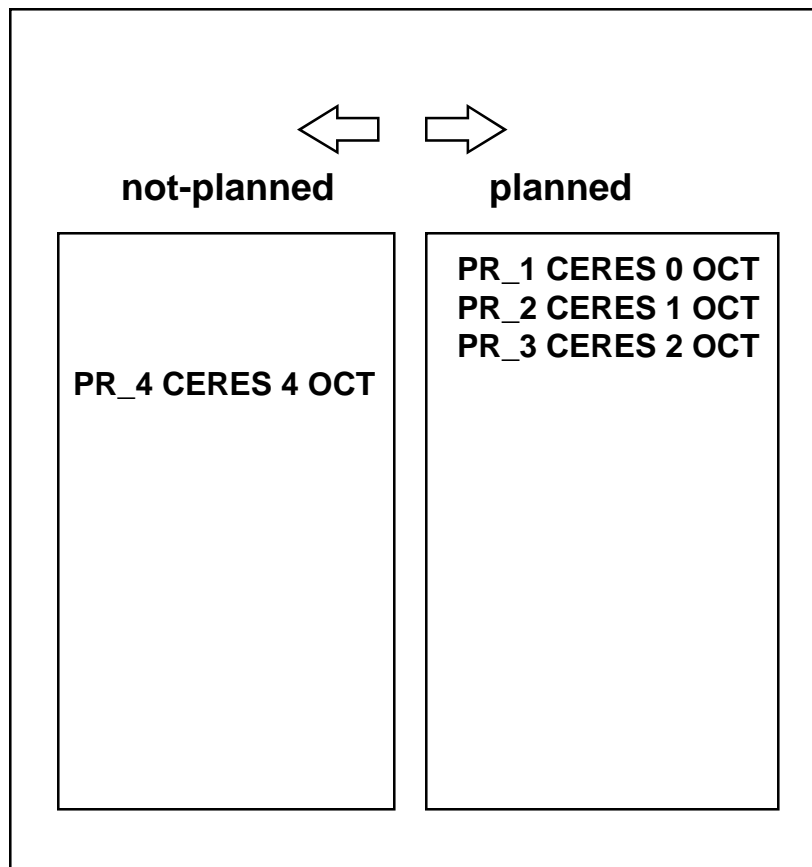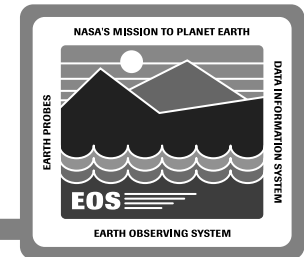
Lists of Production Request define the DPRs to be planned

Planning: Algorithm Goals
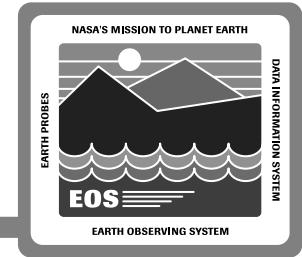
The Planning Algorithm will account for

- **The allocation of resources to ground events**
- **Dependencies between DPRs**
- **Resource Allocation to DPRs**
- **Prioritization of Data Processing Requests**
- **Efficiency of Production**
  - **scheduling tasks sharing data close together**

The Plan should accurately reflect the sequence and duration of the activities which will occur within the Data Processing Subsystem as "coordinated" by the Job Scheduler COTS

Sort Algorithm
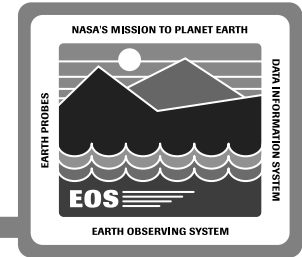
- **Sort DPRs into dependant chains to order chains of tasks where ouput data from one DPR is used as input to another.**

- **Release A algorithm based on data arrival times supports routine production for TRMM data sets**

- **Additional algorithms may be defined for other instruments and processing scenarios.**

Sort Result

Routine Production Scenario

1

L0_10_01 → (PGE_1 10_01) → L1_10_01 → (PGE_2 10_01) → L2_10_01

2

3

L0_10_02 → (PGE_1 10_02) → L1_10_02 → (PGE_2 10_02) → L2_10_02

4

L0_10_30 → (PGE_1 10_30) → L1_10_30 → (PGE_2 10_30) → L2_10_30 → (PGE_3 10_30) → L3_10_30

n   **n+1**   **n+2**

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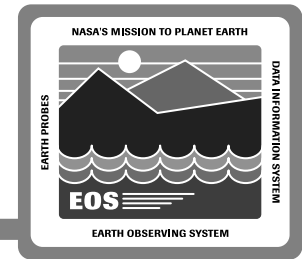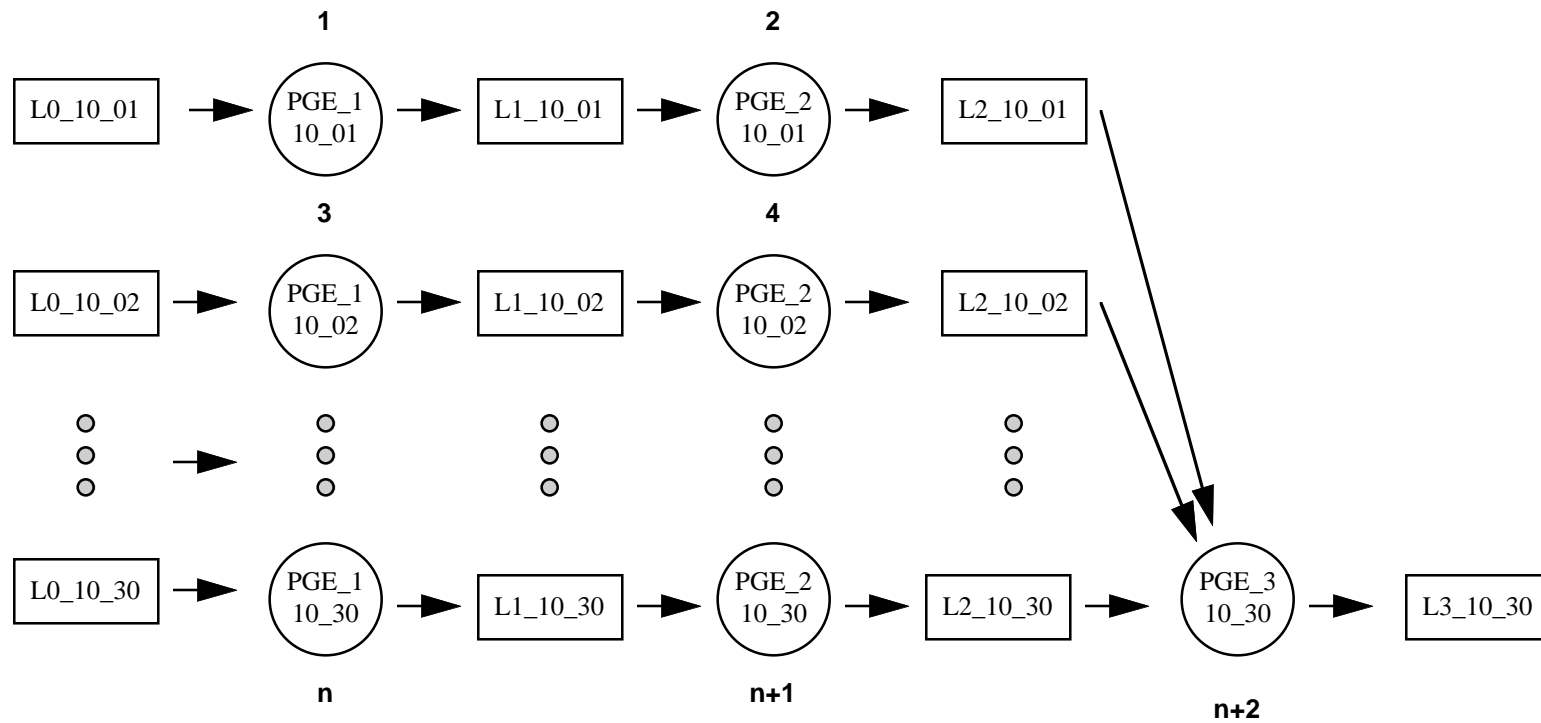
Resource Allocation Description
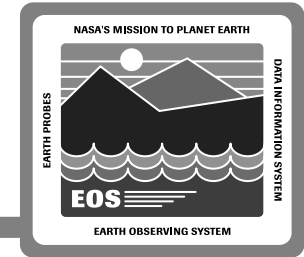
- When more than one DPR at same time take the highest priority from the ordered list.
- Determine the set of computers on which the DPR may be scheduled; iterate over these
- Use the earliest start time for the DPR (latest data availability time) to find out when the computer is first available after that time. Advance time if required services not available.
- Trial allocation of DPR to computer, computer capable of "shifting" ground event within the window.
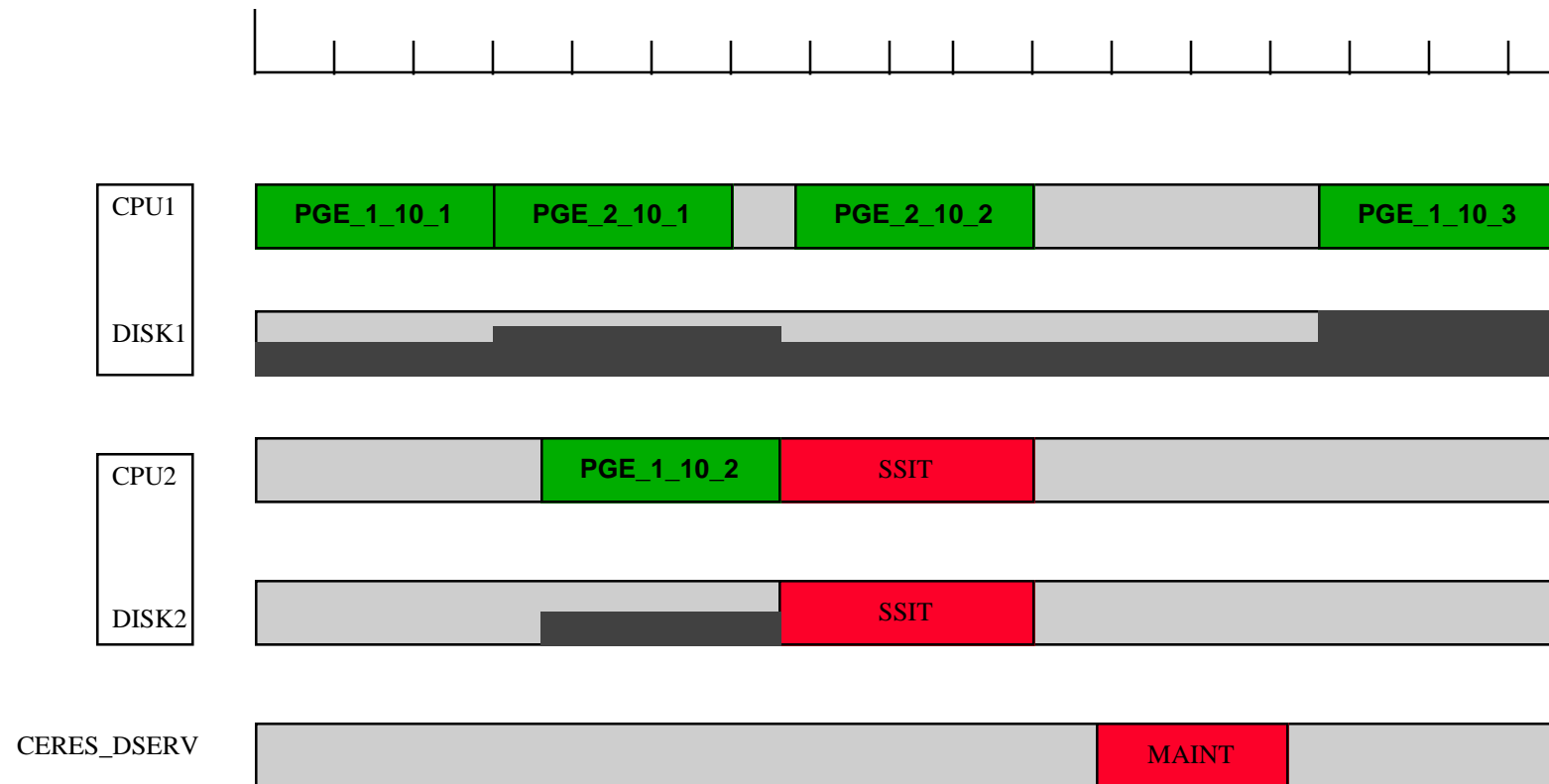- Calculate the "cost" for data staging to that computer
    - cost based on "data transfer" vs. "time of data on disk" to determine relative effectiveness of the trial allocation in view of possible ground events
    - precise formula TBD. clearly a function of file size
    - goal is to allocate chains of PGEs to the same resource
- Allocate to the cheapest resource. DPR allocated to CPU. Files allocated to Disk.
- Update output file predicted times

- Uses same first come first served priority CPU allocation as AutoSys
- Uses same first in first out disk allocation as Data Processing

Resource Allocation Timeline

CPU1							
PGE_1_10_1	PGE_2_10_1		PGE_2_10_2				PGE_1_10_3

DISK1

CPU2				
		PGE_1_10_2	SSIT	

DISK2

| | | | SSIT | |

CERES_DSERV

| | | | MAINT | |

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6. Activating a Plan

active plan

production schedule

**Planning
Workbench**

Data Processing
(AutoSys COTS)

DPR Info

DPR Info,
Plan Info

PDPS Database

**Activating a Plan involves statusing production
"what have we done"**

**then rolling a new portion of the plan into AutoSys
"this is what we want to do"**
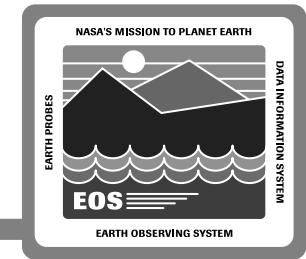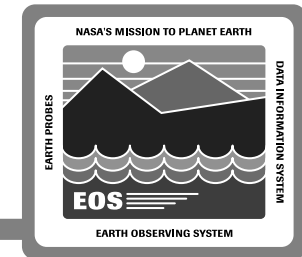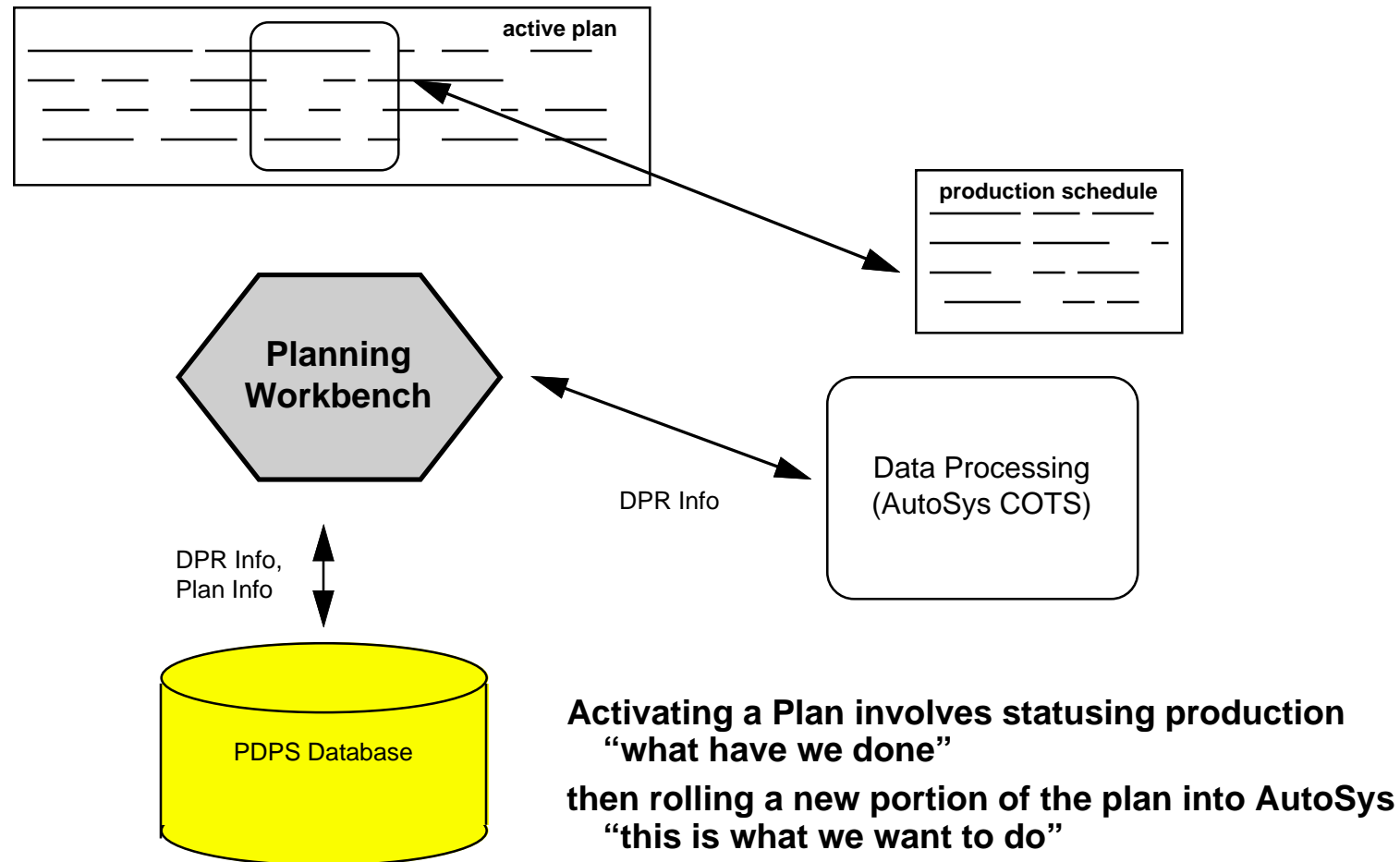
7. Coordinating Production

MSS

Subscription
Manager

Science
Data
Server

Data Processing
(AutoSys COTS)

PDPS Database

lifecycle

commands

1. Notification

2. Inspect
Metadata

3. Release
DPR
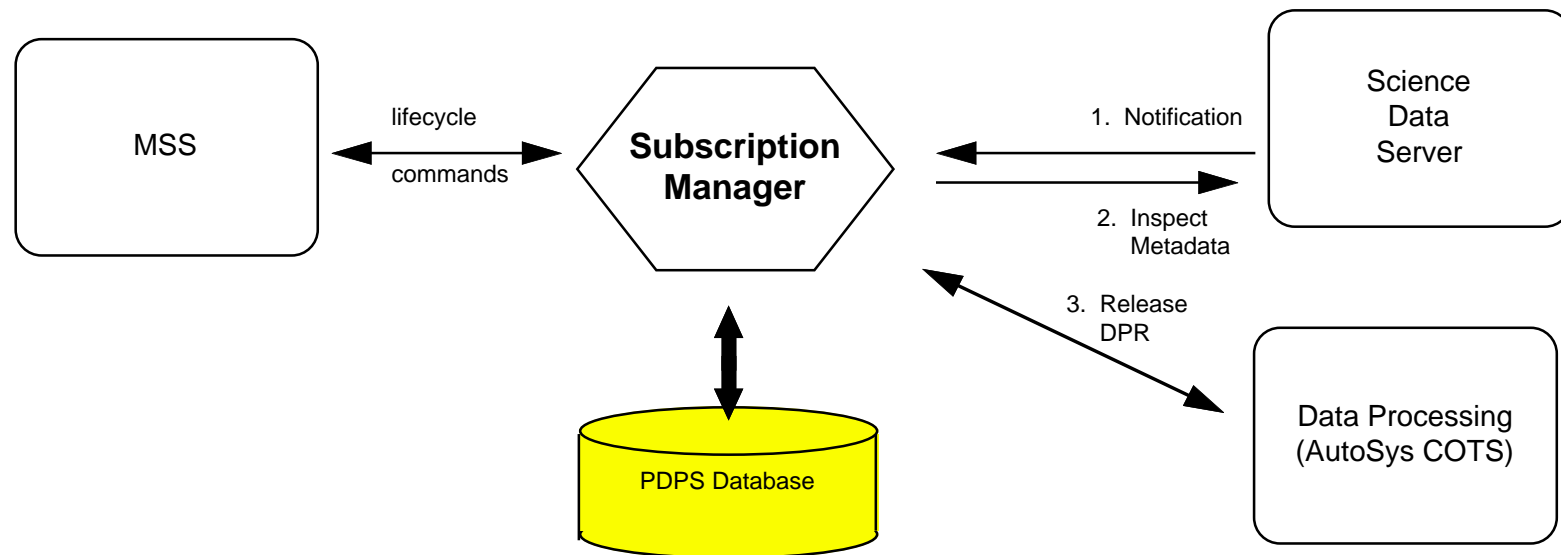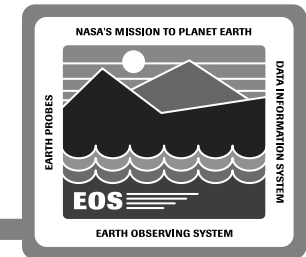
Subscription Manager manages ECS Data Dependencies and converts to AutoSys Job Dependencies

Checks Quality Thresholds for input data

Uses CSS guaranteed asynchronous message passing

8. PGE Execution
(Data Processing)
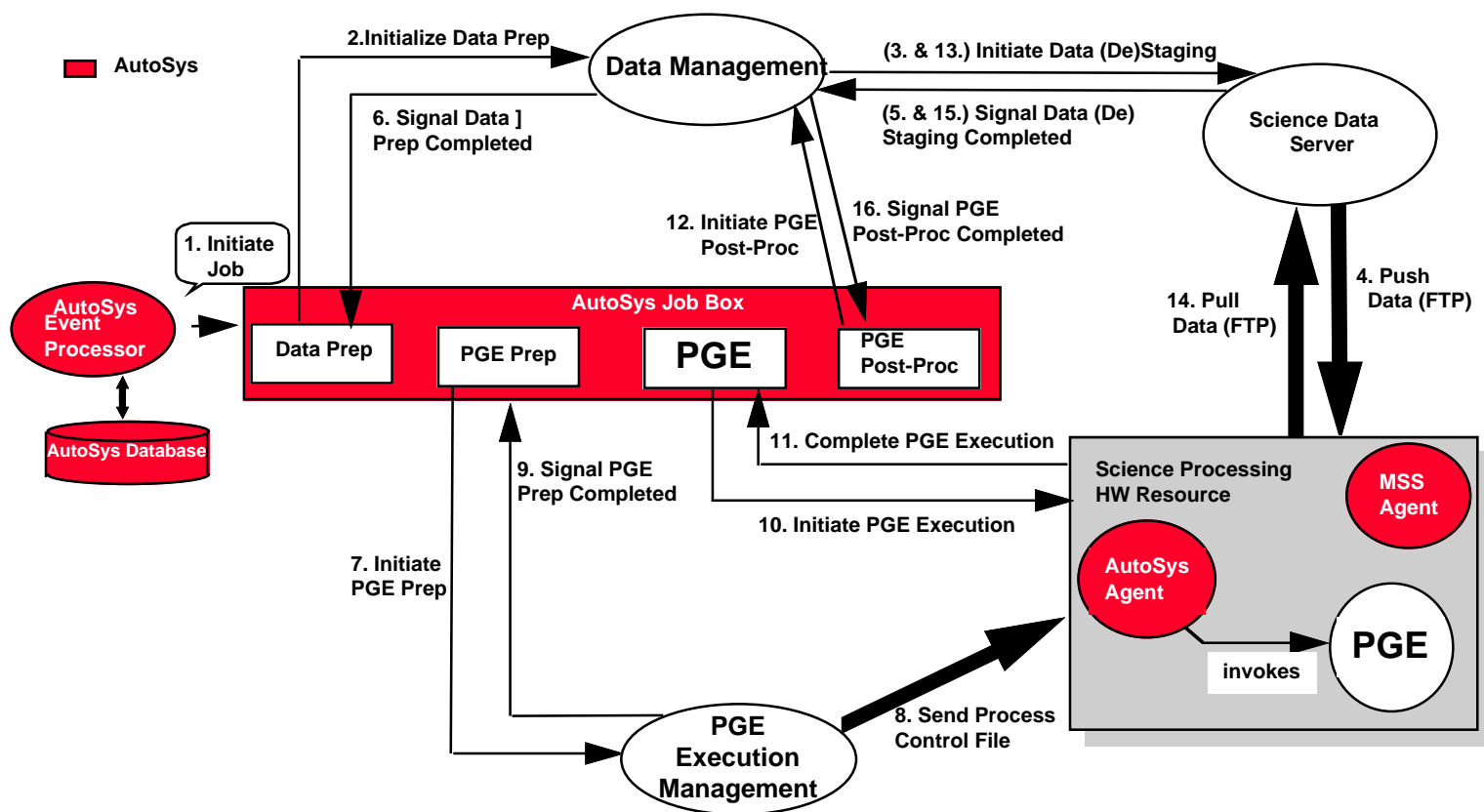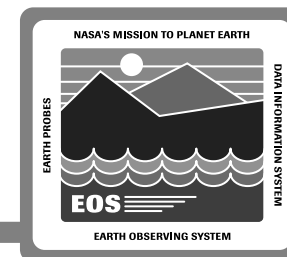
Agenda
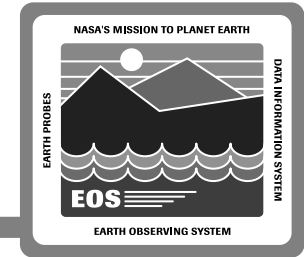
- **Introduction**
- **Planning and Data Processing Subsystem (PDPS) Overview**
- **Science Planning and Production Scenarios**
- **Planning Workbench Design**
- **Planning Workbench Implementation Plan**

Workbench Context

Enter Ground Events

Resource Configuration

MSS

Pre-Planned Activities (GEs)

Develop Plans

Production Requests

Plans, Schedule

DPR

Production

Data Processing Requests

Activate Plan

Plans

DDSRV
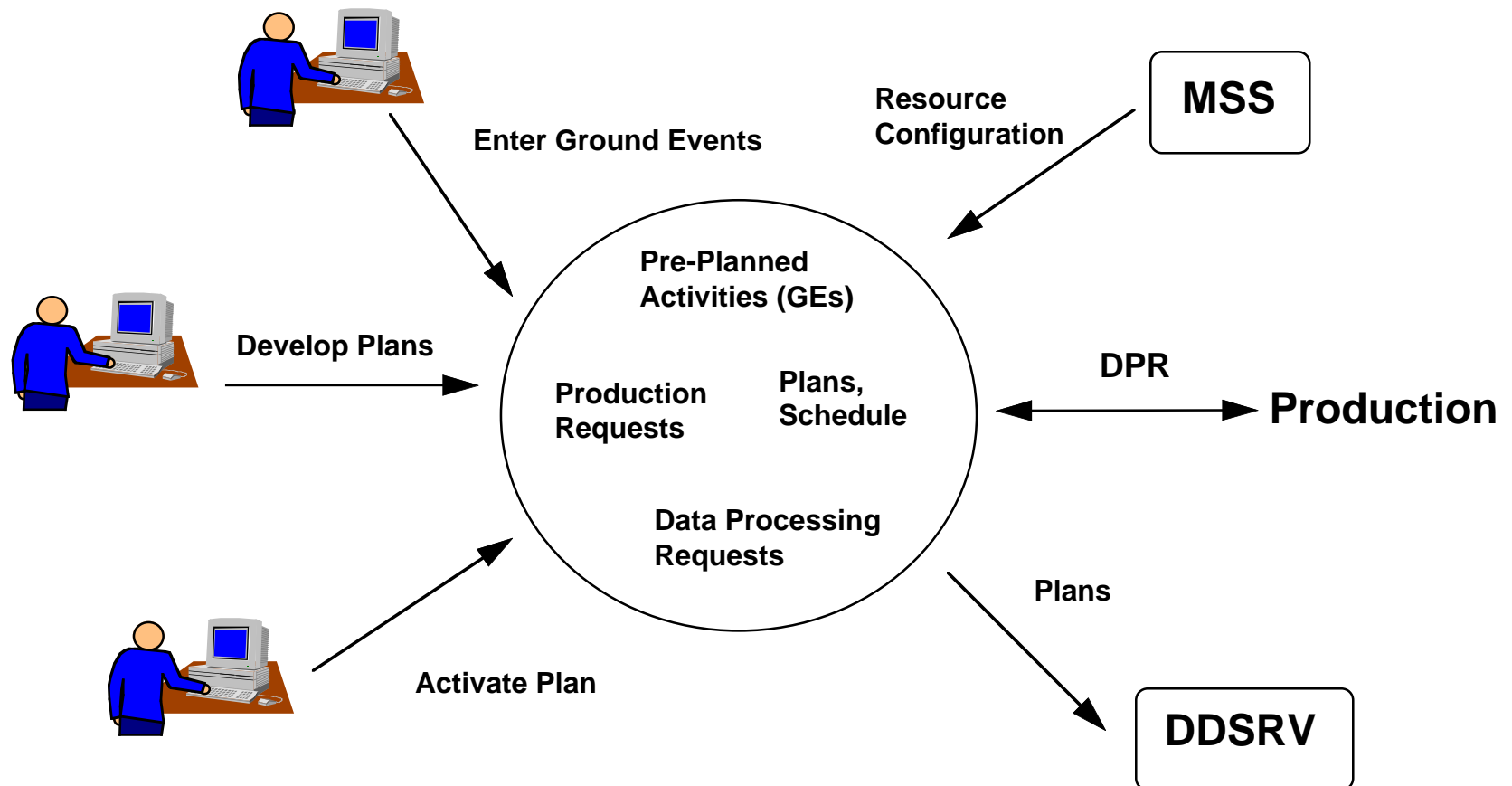
Workbench Architecture

	Timeline Customization (C++)
Workbench UI (Builder Xcessory) MOTIF	**Timeline GUI (Delphi/HCL) MOTIF**

User Interface

Workbench Customization (C++)

Planning Classes (Delphi/HCL)	**Resource Classes (Delphi/HCL)**	**Scheduling Classes (Delphi/HCL)**

Application

	Database Interface (Rogue Wave)
MSS/CSS Services	**PDPS Database (Sybase)**

Services

Workbench Processes

```
┌──────────────────────┐                    ┌──────────────────────┐
│                      │                    │                      │
│ Production Planning  │                    │      Resource        │
│      Timeline        │────┐          ┌────│      Timeline        │
│                      │    │          │    │                      │
│                      │    │          │    │                      │
└──────────────────────┘    │          │    └──────────────────────┘
                    ┌───────┴──────────┴───────┐
┌──────────────────│                           │──────────────────┐
│                  │                           │                  │
│ Production Plan  │   System Resource Model   │  Ground Event    │
│     Editor       │                           │     Editor       │
│                  │                           │                  │
└────────┐         └─────────────┬─────────────┘         ┌────────┘
         │             ┌─────────┴─────────┐             │
         └─────────────│                   │─────────────┘
                       │   PDPS Database   │
                       │                   │
                       └───────────────────┘
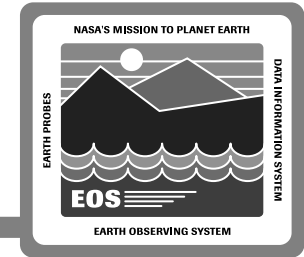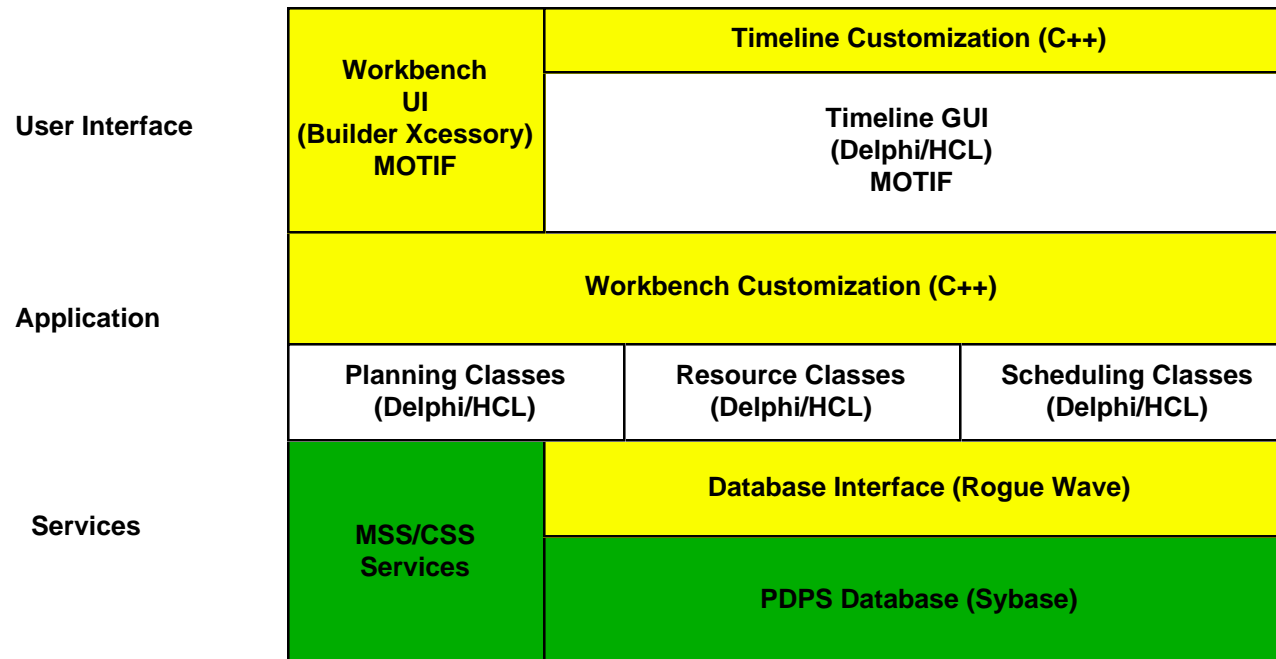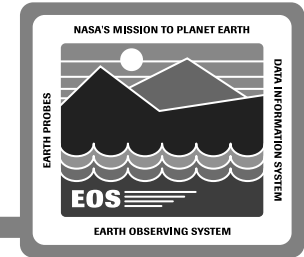```

# Workbench High Level Model
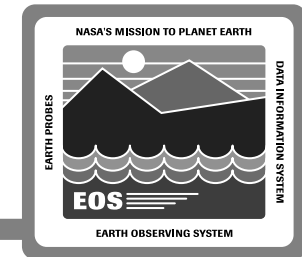
# Agenda

- **Introduction**
- **Planning and Data Processing Subsystem (PDPS) Overview**
- **Science Planning and Production Scenarios**
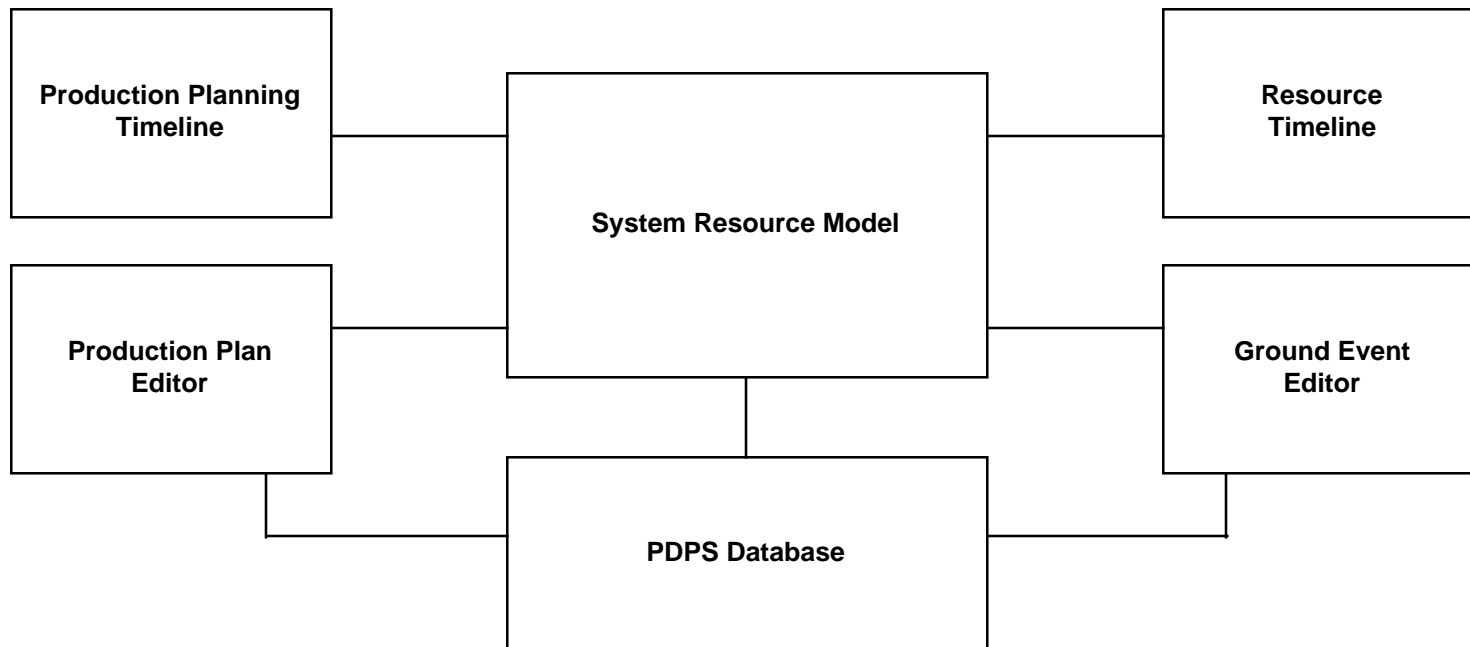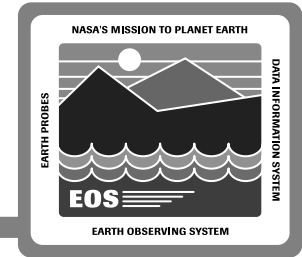- **Planning Workbench Design**
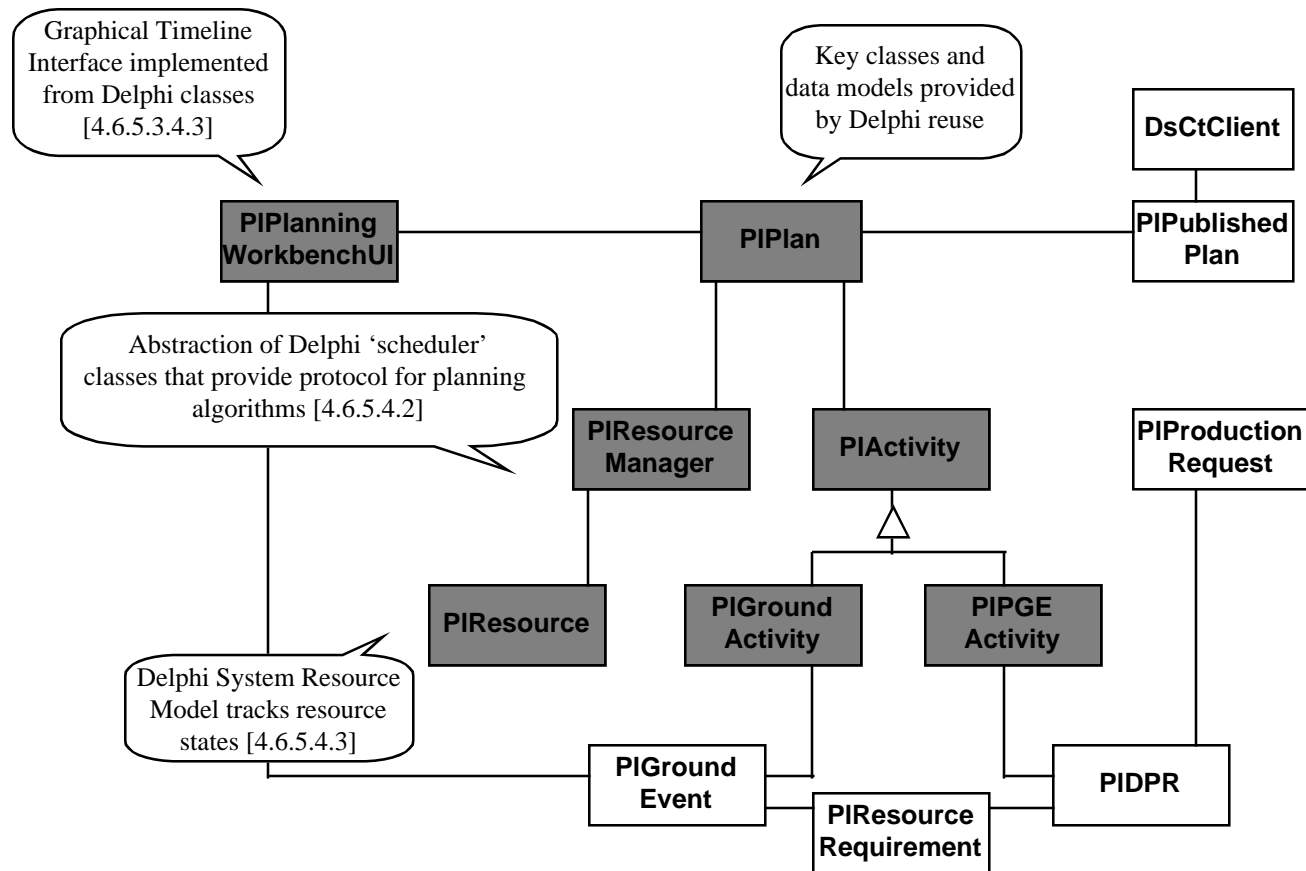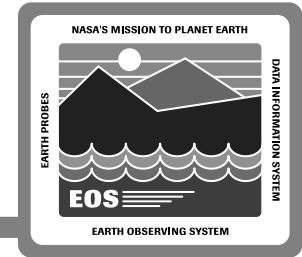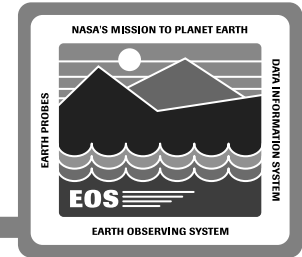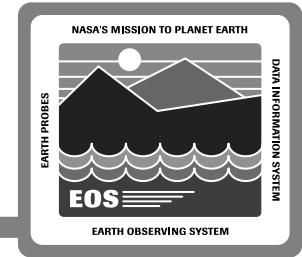- ➤ **Planning Workbench Implementation**

# Planning Workbench Sizing

- **Sizing Estimates**

  - **Custom Code:  5500 SLOC (18000 for Planning Subsystem)**

  - **Delphi re-use:  2000 SLOC equivalent application code**
                    **+ GUI re-use**
- **This is the CDR Baseline (NO CHANGE)**
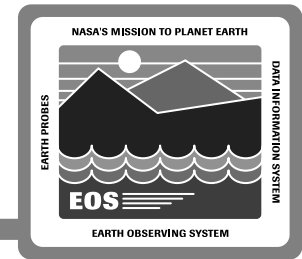
# Planning Workbench Implementation Schedule

- **Three-phase Implementation for Release A**
  - **Phase 1 Ends December 1995**
  - **Phase 2 Ends March 1996**
  - **Phase 3 Ends June 1996**

- **Allocation of Planning Workbench To Implementation Phases**
  - **GUI Development - Phase 1**
  - **Early Development of the Planning Algorithm - Phase 1**
  - **Code and Test - Phase 2 and 3**

# Conclusion

For the "best laid plans" . . .

## THE PLANNING WORKBENCH